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WASHINGTON, D.C. 20548

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JANUARY 22, 1980

B-197440

The Honorable Henry M. Jackson
Chairman, Committee on Energy
and Natural Resources
United States Senate 06300

The Honorable Mark O. Hatfield
Ranking Minority Member, Committee
on Energy and Natural Resources
United States Senate

Subject: [Oil and Gas Potential in the Arctic National Wildlife Range] (EMD-80-56)

In a December 20, 1979, letter, you asked us to provide our opinion on whether the data in "Petroleum Source Rock and Reservoir Quality Data from Outcrop Samples Onshore North Slope East of Prudhoe Bay" (United States Geological Survey (USGS) open file #79-1634) supports many analysts' contentions that the rocks of the Arctic National Wildlife Range have a potential for producing oil and gas.

DLG 03735
Alaska

In that report, the State of Alaska and USGS compiled and published the results of laboratory analyses providing geochemical, physical, palynological and paleontological data on 74 to 81 surface rock samples collected between Prudhoe Bay and the Canadian border. This data was provided in an uninterpreted format "in order that they be made available to the public prior to the Beaufort Sea Sale." The authors did not interpret the data or draw any conclusion from it. Therefore, the report had no conclusion concerning the Range's potential to produce oil or gas. The report presents raw data for others to evaluate and interpret.

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In our opinion, the data supports a position that the potential for oil and gas definitely exists in the Range. This potential, however, should not be construed to mean that reservoirs exist, that they will be found, or that they will be large enough to be economically produced. The existence of large oil or gas resources can only be confirmed by drilling.

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gas resources
oil resources
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Extractive
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SCOPE OF OUR WORK

Between January 4 and 17, 1980, we reviewed the data presented in the report and discussed the report and the Range's oil and gas potential with State of Alaska and USGS officials and geologists (including three of the report's authors), and geologists with Shell, Exxon, Atlantic Richfield, and Dome Petroleum.

POTENTIAL EXISTS FOR OIL AND GAS RESERVOIR CONDITIONS

In our opinion, the data in the USGS report shows a potential for oil and gas in the area. In addition, the data adds to the body of knowledge concerning the area. However, the data cannot by itself, or in combination with earlier geologic reports, assure that the necessary geologic conditions exist together onshore or that, if they do exist, the resultant reservoir(s) is large enough to be economically produced. Such a determination requires additional data collection and analysis, and drilling.

Before oil and gas can be produced, three things are needed in combination--origin or source rock, reservoir rock to hold the hydrocarbons, and a trapping mechanism to stop hydrocarbon migration and contain the hydrocarbons. The data in the USGS report concerns only the first two items.

Origin or source rock

Organic matter in a source rock forms petroleum through a series of complex chemical reactions. The concentration, type, and thermal maturity of the organic matter determine the quality and quantity of petroleum formed.

Data in the USGS report shows that the proper organic and thermal conditions have occurred to generate petroleum. Many of the surface samples collected contain one type of the proper organic material (Amorphous-Sapropel) and the necessary thermal maturity (demonstrated by a Thermal Alteration Index) to form oil. Most of these contain a second appropriate compound (Herbaceous-Spore); others contain a third appropriate type (Woody) as well. In addition, a few other samples show appropriate organic matter (Herbaceous and Woody) and possible thermal maturity.

Reservoir rock

Porosity and permeability tests assess a rock's ability to hold and produce oil or gas. Porosity refers to the void space, or the rock's ability to hold oil. Permeability refers to the rock's ability to "give up" or produce its petroleum.

About one in four (21 of 76) of the samples tested have the porosity necessary to indicate a reasonable potential to be reservoirs. Of these, over one-third (8) have the permeability to produce any petroleum that they might contain; another one-third (7) have a questionable potential to produce.

A limitation in the porosity and permeability data exists. The data does not tell us the mineral content (constituency) and whether secondary mineralization has occurred, that is, we don't know if some original minerals have been replaced by other minerals. If such secondary mineralization occurred, the porosity and permeability at thousands of feet below the surface could be different. Although this report contained no such data, USGS advised us that thin section slides have been prepared for microscopic analysis and the results of the analyses will be published.

OTHER CONSIDERATIONS

Notwithstanding this limitation, the preceding data supports a view that the rocks of the Arctic National Wildlife Range have a potential for producing oil and gas. Several other factors also lend support to this view:

--The Range contains several oil seeps and outcrops of oil-stained sandstone.

--Rocks known to contain hydrocarbons in the Prudhoe Bay field are folded and faulted into structural traps visible at the surface within the Range.

--Gas and oil discoveries have occurred just west of the Range.

--Gas and oil discoveries in the MacKenzie River Delta region of Canada are in similar geologic terrain just east of the Range.

Finally, the people we interviewed agreed that the report definitely supports the contention that the rocks of the Range have a potential for producing oil and gas. In addition to the geologist-authors, these people include the State and Assistant State Geologist for Alaska, the Arctic geologist for USGS, and five geologists with four major oil companies.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of issuance. At that time we will send copies to interested parties and make copies available to others upon request.

Comptroller General
of the United States